Long Term County Level Economic Forecasts: Methodology Update

By Mark Schniepp
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Introduction

This methodology update describes the modeling system and data used to forecast the county level economic indicators for the California Department of Transportation. The county models comprise an elaborate forecast system for projecting economic activity regionally in the state.

The modeling system has been continuously updated and improved since the start of this project back in 2000.

The Econometric Model: A Brief Description

The county models are independent: there is a totally autonomous model for each county economy. Each model is comprised of 6 blocks of equations: 45 stochastic behavioral relationships and 24 accounting identities. The model is characterized by simultaneous interaction and determination of local employment, income, population, wages, retail spending, and the demand for housing

The stochastic equations are estimated as regression equations and the entire system is solved using the Gauss-Seidel algorithm.

The model is a "satellite model," requiring forecasts of various California and U.S. economic variables which are treated as exogenous to the local county area.

The county-level models are each moderately detailed. The 69 equation system is estimated separately for each county. All of the stochastic equations to be evaluated each time new data is introduced into the models or re-specification of the model is undertaken.

The models are county-specific, and the specifications are built with the objective of considering unique attributes of each county economy.

Outputs

The initial economic and demographic indicators that are forecast for each county are shown in the table below. Forecast values are prepared over a 30 year period beginning with the year in which actual data are not yet available.

Forecasts are derived for each county independently.

Table
The principal economic indicators which are forecast by the California County econometric models

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- Non-farm employment by principal two digit NAICS sector
- Farm employment
- Total wage and salary employment
- Personal Income
- Per capita personal income
- Number of housing units permitted and total housing stock
- Taxable retail and total taxable sales
- Population (and births, deaths, net migration)
- Number of households
- Number of vehicle registrations
- Existing Home Sales
- Median Housing Values
- Total Agricultural Value of products

INDUSTRIAL AND FARM INDICES

The farm index is derived from the value of all agricultural products produced in the county, adjusted for inflation. The value in 1990 is made the base year, and indexed to 100.

In most cases counties do not dramatically expand farm production, and the farm index remains relatively flat.

The Industrial production index uses gross state product information (gross product or output per worker) provided from the Bureau of Economic Analysis, Department of Commerce for four industrial sectors: mining, non durable manufacturing, durable manufacturing, and transportation. Forecasts of productivity are provided by UCLA.

The productivity of workers (output per worker) in each of these sectors is combined with the forecasts for county employment to estimate gross county product originating in each industrial sector. The sum of all industrial production in the four sectors is indexed to the base year 1990 so that it can be compared directly with the Farm Index over time.

MODEL STRUCTURE

General Characteristics

The county models are a macroeconomic structure consisting of 69 interdependent equations. Each endogenous variable (determined by the model) is a function of other endogenous variables, exogenous variables (determined outside the model), and an error term. Implicitly, each equation may be represented as:

$$Y_{it} = f(Y_{jt}, X_{kt}, u_t)$$

Where

Y_{it} = endogenous variable i in period t
Y_{jt} = endogenous variable j in period t
X_{kt} = exogenous variable k in period t
u_t = error term in period t

The determination of Y_{it} by a variable determined elsewhere in the model, is the essence of a simultaneous equation model. The endogenous variables interact within the model as they do in the real world.

The structure of the model is a simultaneous, arranged in blocks of equations. Each block is comprised of a system of equations that comprise the block, or sector. All sectors are linked, meaning feedback exists between blocks. The equations within each block are either stochastic (that is, measured with error) or deterministic (i.e., are determined by an identity or formula having no measurable error).

The equations have been arranged in 6 blocks to aid in organizing the model.

Sector 1: Housing and New Building
Sector 2: Demographics
Sector 3: Income
Sector 4: Consumer Spending
Sector 5: Employment
Sector 6: all other equations including the Farm sector

For each sector, a particular set of endogenous variables are specified to meet the initial objectives of the county forecasting model. A number of other endogenous variables are needed as intermediate stages in the determination of the key variables that are to be reported.

Estimation Period

The database associated with each County was assembled from as far back in time that data is currently available to the most current year, 2009. Annual observations are used in the estimation, and forecast.

Due to the varying availability of economic and demographic data the sub-national level, each block in the system has its own number of observations associated with it. Consequently, the estimators calculated for the forecasting equations were derived from varying numbers of observations.

For the **Employment block**, most of the large counties and SMSAs included data that began in 1972.

Income data for all Counties starts in 1969, and therefore, the income block includes 39 observations for all 58 Counties in California.

For the **Housing Sector Block**, the number of households and housing stock begin in 1980 for most counties. For some of the smaller counties, the data starts in 1984. The building permit data all begin in 1969 for all Counties in California. Median home selling prices typically begin in 1989 for all Counties. For some of the larger counties including the east bay area, data began in 1982.

The **Consumer spending block** which consists of retail sales and retail store permits begins for all Counties in 1969.

In the **Demographic block**, the observations begin in 1970 or 1980. Population in all cases begins in 1970. Net migration, births, deaths, and population by age also begin in 1970. For some of the large counties, vital statistics data is available from 1947 to present.

For the **Farm sector**, data is available beginning in 1972. The CPI for the north and the southern parts of California, and the California composite CPI is available from 1920 to present. The statewide home mortgage rate begins in 1970.

ENDOGENOUS FACTORS
(ECONOMIC INDICATORS THAT ARE FORECAST)

These variables are left hand side variables that are modeled using a behavioral relationship specification comprised of both exogenous factors and other endogenous variables.

There are more endogenous economic indicators forecast as part of the modeling system than we typically present in the county forecast presentations. This is because many more endogenous variables need to be forecast because they are used as exogenous factors for indicators that are core economic indicators.

Sectors of the Model

The model is arranged into 6 sectoral blocks of equations. However the blocks are not recursive, that is, they are not estimated independently and determined (or solved for) sequentially. The models are characterized by simultaneous interaction and determination of local employment, income, population, wages, and housing demand.

Housing and New Building

Stochastic equations

HH = households
SFU = single family units
MFU = multiple family units
RBVRTOT = real residential building value permitted
RBVNRTOT = real non-residential building value permitted
RABVRN = real average building value for new residential units
RHP = real median home selling price
HSALES = existing home sales index

Identities

HS = housing stock: HS = HS(t-1) + UNITS(t-1)
UNITS = new single and multiple family housing permits: SFU + MFU
SFRAT = ratio of single family units to total residential units permitted:
SFU / UNITS
RBVTOT = real total building value permitted = RBVRTOT + RBVNRTOT
HPRAT = ratio of county median price to national median selling price:
RHP/ZRHPM
where ZRHPM = real median home selling price nationally

Demographics

Stochastic equations

BIRTHS = births (calendar year series)
DJUL = deaths (July series)
DEATHS = deaths (calendar year series)
NIPJUL = net in-migrating population (July-June series)
VEHICLES = number of registered vehicles
UR = unemployment rate
ELF = employed labor force
CLF = civilian labor force
Autos = number of registered cars

Identities

POPJUL = population (July 1): = POPJUL(t-1) + BIRTHS – DEATHS + NIPJUL
POPJULPC = population growth: (POPJUL(t)-POPJUL(t-1))/ POPJUL(t-1)
DPOP = change in population: POPJUL(t) – POPJUL(t-1)
PPV = persons per vehicle: POPJUL/VEHICLES
DENSITY = persons per household: POPJUL / HH

Income

Stochastic equations

RYTP = real transfer payment income
RYDIR = real property income (asset income)
RYPROP = real proprietor income
RYRA = real residence adjustment income
RYEPW = real average earnings per worker (average salary per worker)

Identities

RYTWS= real total wage and salary earnings = ETWS*RYEPW
RYP= real total personal income = RYTWS+RYDIR+RYTP+RYPROP+RYRA
RYPPC = real per capita personal income: RYP / POPJUL
PYPPCPC = real per capita income growth: (RYPPC(t)-RYPPC(t-1))/RYPPC(t-1)
WAGERAT = ratio of local average salary
to the average salary in California: RYEPW / RASALCA
(where RASALCA = real average salary in California)

Consumer Spending (retail sales)

Stochastic equations

RQRS = real retail sales (taxable retail sales)
QRSTORES = number of retail outlets or stores
RQTRS = real total taxable sales

Identities

RQRSPS = retail sales per store = RQRS / QRSTORES
SALESRATE = ratio of retail sales to personal income = RQRS / RYP

Employment (non-farm sector)

Stochastic equations

EMIN = employment in mining
ECON = employment in construction
EMFG = employment in manufacturing
EDUR = employment in durable manufacturing
ETPU = employment in transportation, communications, and public utilities
ERT = employment in retail trade
EWT = employment in wholesale trade
EI = employment in information
EFA = employment in financial activities
EPRO = employment in professional and business services
EEDUC = employment in education and healthcare services
ELEISURE = employment in leisure, accommodation, and recreation services
EOTHER = employment in other services
ESLG = employment in state and local government
EFG = employment in federal government

EPROP = number of proprietors (self-employed individuals)

Identities

EGOVT = employment in government = ESLG+EFG
ETWS = total wage & salary employment =
sum of all non-farm employment sectors plus the farm sector

DETWS = change in total employment: ETWS(t) – ETWS(t-1)

EMPRATE = employment to population ratio: ETWS / POPJUL
ETWSG = growth rate of employment: (ETWS(t)-ETWS(t-1))/ ETWS(t-1)

Farm Sector and misc. equations

Stochastic equations

EFARM = wage and salary employment in farming
RCROP = real total agricultural crop value
I = southern or northern California inflation rate

Identities

CPILA (SF) = Consumer Price Index, Southern (Northern) California
= CPILA(t-1)*(1+(I/100))

EXOGENOUS VARIABLES

There are a total of 111 exogenous variables in the initial development of the model. Not all of these exogenous variables are used. However, these variables have been found to be important in the original specification tests. The exogenous variables will be updated and made available for model development and enhancement over time.

Currently, all blocks are driven by exogenous factors, as well as endogenous factors that are determined in other blocks of the general model.

The exogenous variables include the following:

California economic and demographic variables: There are 72 variables to draw on.

National economic variables: There are currently 23 variables that have been utilized in the model development process.

Local county demographic variables: These factors are age specific population counts from the Department of Finance. The model uses 10 of these to drive various equations in the Employment and Demographic blocks of the model.

Housing variables: median home price, sales, mortgage rate, notices of default and foreclosures in California, and National home price.

The exogenous variables are obtained from the December 2009 UCLA Anderson Forecast for the State and Nation. The local county demographic variables are age specific populations that are estimated by the Department of Finance, Demographic Research Unit every 2 years. Housing variables are developed in an independent housing model for California and the Nation. See below.

Some naming conventions associated with the exogenous variables:

- All U.S. exogenous variables begin with a "Z".
- All California exogenous variables end with the letters "CA".

HOUSING MODEL

The housing model uses exogenous inputs from the UCLA California and National forecasts.

Past trends in housing, such as sales, mortgage rates, and prices, as well as economic variables such as employment, income, and building are used to predict the future direction of the housing market, in terms of sales and housing values. The model does not attempt to forecast future housing cycles, but rather provides reasonable estimates for what can be expected given the future demand for housing, plausible income estimates, and constraints on new home production.

The national median home value for new housing and for existing housing are interrelated. An exogenous forecast for one will provide us with an attendant forecast for the other.

National home values influence statewide housing prices. The U.S. median home selling value for existing homes has a large impact on median home selling values in California.

Home sales in California influence the rate of sales in most counties, though the variation in county home sales in further influenced by local job creation, population growth, and homeowner distress.

California home values influence county level values, along with other local influences such as housing production and job creation. Interest rates also typically have an impact, both on home values and on home sales

Because of the critical importance that homeowner distress has had on the housing market during this current real estate cycle, notices of default and foreclosures have been added to the housing model. The forecast of future homeowner distress has a meaningful influence on the timeframe for recovery in the housing market.

<u>Note of the direction of the housing market in 2010</u>

The results of the model show a market clearly in recovery starting in 2009. Homeowner defaults and foreclosures are not expected to relapse at any point over the next few years. This leads to more sales at higher prices throughout the forecast. This result generally impacts the entire county economic outlook.

DATABASE, DATA SOURCES

The database is an extensive collection of County-level economic and demographic variables from a myriad of sources in California. The database spans the period: 1947 to 2009.

Indicator	Primary Data Gathering Source
Taxable Retail Sales	State Board of Equalization
Retail Store Outlets	State Board of Equalization
Total Taxable Sales	State Board of Equalization
Personal Income	Department of Finance, Economic Research Unit*
Components of Pers. Inc.	Department of Finance, Economic Research Unit*
Employment	Employment Development Department, LMID
Unemployment Rate	Employment Development Department, LMID
Vehicle Registrations	Department of Motor Vehicles
Births, Deaths	Department of Health Statistics
Population, Net Migration	Department of Finance, Demographic Research Unit
Residential building permits	Construction Industry Research Board
Non-residential bldg. Permits	Construction Industry Research Board
Median Home Selling Price	California Association of REALTORS©
Existing Home Sales	California Association of REALTORS©
Farm Sales	California Agricultural Commissioner
Households	Department of Finance, Demographic Research Unit
Housing Stock	Department of Finance, Demographic Research Unit

* obtained from the Department of Commerce, Bureau of Economic Analysis

Constant Dollars

All county-level dollar variables are deflated using the local consumer price deflator or the statewide implicit price deflator. The base year is the most recent calendar year just completed.